

FIXING RADIOS

AN ILLUSTRATED GUIDE TO THE REPAIR OF RADIO SETS

No. 2 **How To Use Radio Tools**
RADIO SERVICING METHODS



NRI TRAINING

Pays...

Dear Mr. Smith:

I cannot praise NRI and its staff too highly. I started to earn a little about the twelfth lesson; by the time the Course was completed, I had earned enough to pay for the Course and buy a tube tester and other servicing equipment. At present I am doing part-time service work - making on an average of \$75 per month, and getting a larger amount of business every day. I value my training more every day.

G.E.H., Penna.



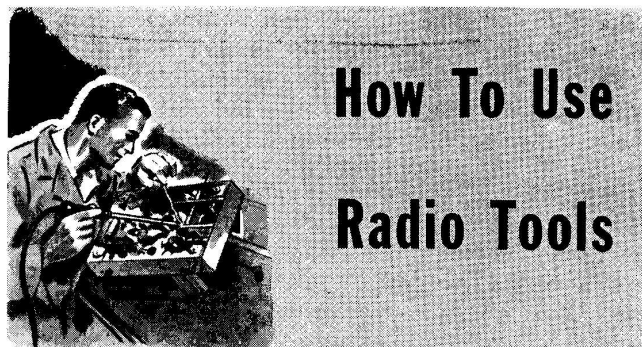
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ONE of the many good features of radio servicing as a profession is that you need not invest much money in tools to get started. The familiar, every-day tools shown in Fig. 1, along with the soldering iron that we will send you, will be all you'll need for the experiments of your Practical Demonstration Course and for your first servicing jobs. Although you will need a few more as you advance, tools will never be a major expense.

This does not mean that tools are unimportant in servicing. Quite the contrary—you will use them constantly, and, to make fast, neat, professional repairs, you must know how to use them properly. This Booklet will teach you what tools to use and how to care for them. Details on their use will be in other RSM Booklets.

We will describe three groups of tools. First are those you will need for all radio jobs, both in the customer's home and at your bench. Next are tools that you will need occasionally at your bench. Last are those that you will want when you develop so large a business that it is profitable for you to use time-saving equipment in spite of its initial expense.

GENERAL FACTS ABOUT TOOLS

Before discussing individual tools, let's get some practical pointers on tools in general.

First—**NEVER BUY A TOOL YOU DON'T REALLY NEED.** To tie up your capital in tools and equipment that you use very seldom is poor business—and

you must be a good business man as well as a good repair man to succeed in radio servicing.

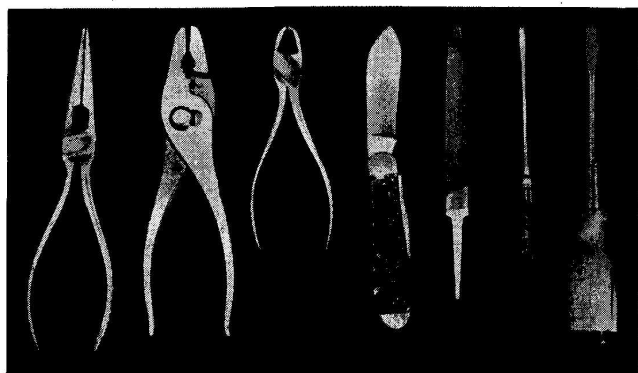
Since the tools in Fig. 1 are so common, you may already have them all. If you must buy one or two, buy the best you can afford. You can always do better, faster work with high-quality tools. If you must get your first ones at the "five and ten" or the bargain counter of a hardware store, buy better ones as soon as your servicing profits give you the money to do so.

Care of Tools. Start from the beginning to use a tool only as it is intended to be used. Never, for instance, use a good screwdriver as a chisel or a screwdriver handle as a hammer. Have a place close at hand for your tools so that you can pick them up and lay them down without tossing them across the workbench. Good tools will last a long time if not abused.

Above all, *be neat*—it will save you time. Have a place at your bench for each tool, and teach yourself to put back the tool in its proper place when you're through with it—or, if you intend to use it again soon, lay it in a nearby work tray. Nothing is more annoying or kills more time than having to hunt for a tool lost on a cluttered bench.

► For the same reason, as you take screws, nuts, dial knobs, and other small parts out of a set, put them in a small box, a tin can, or a jar. Then, if you have to put

FIG.1. The soldering iron we send you, plus these few tools that you supply yourself, are all the tools that you need to start servicing.



A disorderly, cluttered workbench can cost you money—you may waste many hours of valuable time looking for misplaced tools and parts.



Keep your tools in a rack—keep small parts and tools you're using in a work tray—and you'll find you can work much faster.

the receiver aside for a while, these parts won't be lost.

Keeping things in order will help you develop a logical, orderly work-procedure which will save the maximum amount of time.

Keep your tools and your tool box thoroughly clean. Use clean dustcloths to wipe off dust and moisture. To protect the tools, oil them regularly. Dip them into a flat pan containing light oil, then wipe them thoroughly dry. Just enough oil will remain on the surface to prevent rust. Don't leave excess oil on the tools—it will make your hands dirty, leave spots everywhere you lay the tools, and collect dust and dirt.

► A customer will be impressed either favorably or unfavorably by the *condition* of your tools, not by their number. Rusty, broken tools are certain to make him wonder if you should work on his radio.

We'll now discuss the various tools you'll need—indicating in each case whether you should have the tool soon or can wait for some time before you get it.

PLIERS

Fig. 2 shows typical styles of the most useful types of pliers. One of each type will eventually find its way into your kit of tools.

Long-Nose Pliers. There are several styles of long-

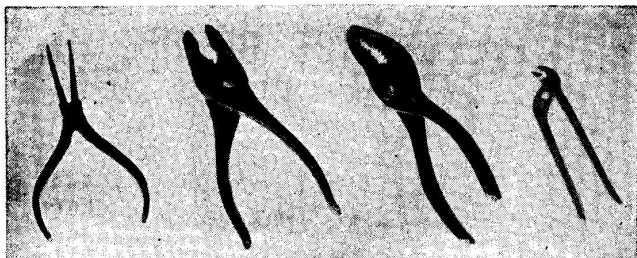


FIG. 2. These are the pliers you'll use most—long-nose, straight-nose auto, bent-nose auto, and ignition pliers.

nose (sometimes called thin-nose or needle-nose) pliers. The types in Figs. 1 and 2 are most commonly used, but suit your own preferences. In any case, be sure to get a pair with jaws that meet squarely and have no side play.

Fig. 3 shows two major uses of long-nose pliers. Don't try to loosen a nut with them in the manner shown in Fig. 4. You will spring the jaws so that they no longer meet squarely. These pliers are intended only for light-duty *holding* or *pulling*, not for heavy *twisting*.

Automobile Pliers. Both straight- and bent-nose slip-joint or automobile pliers are useful for removing large nuts. The bent-nose type is preferable because it helps you to remove nuts close to the chassis or the chas-

FIG. 3. Common uses of long-nose pliers: A, holding a wire for soldering; B, bending a loop in a wire.

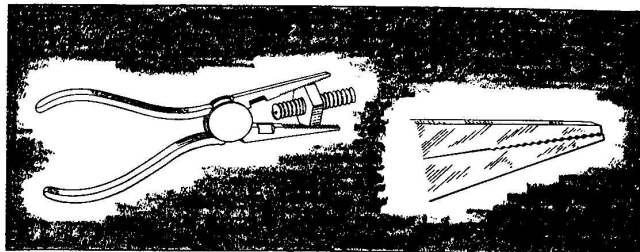
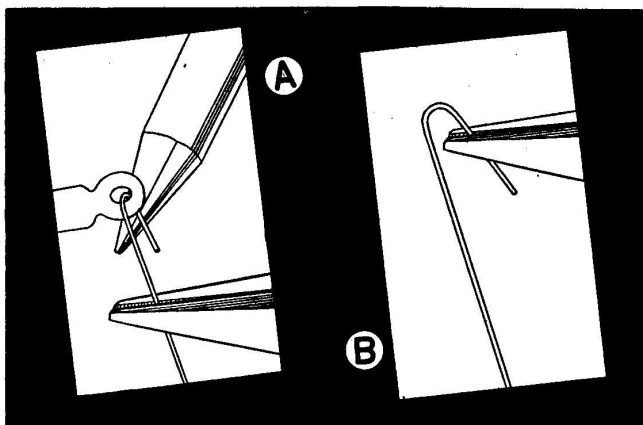


FIG. 4. Loosening a nut with long-nose pliers in the manner shown will often spring the jaws.

sis wall. Buy a pair made from thin stock, as it will be easier to use them in crowded places.

Ignition Pliers. The ignition pliers shown in Fig. 2 are lighter and less bulky than automobile pliers, but are surprisingly powerful. They are useful on small nuts, on nuts in hard-to-reach places, and in adjusting certain loudspeakers.

CUTTING TOOLS

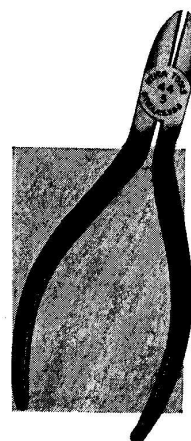
Side-cutting Pliers. Side-cutting pliers are used to snip the wires off defective parts, to cut pieces of hook-up wire from a roll of wire, to cut connecting leads to the proper lengths, and to cut off soldering lugs. The side-cutter shown in Fig. 5 is used because it is easier to get under wires and other parts than are other cutters. You will need side-cutters right away; get a pair about 5 or 6 inches long.

Cheap side-cutters are a waste of money. Before buying a pair, close the jaws (but don't squeeze the handle tightly), and hold the pliers against the light. The cutting edges should fit together perfectly (see Fig. 6). If you can see light between the cutting edges, the pliers will not cut insulation cleanly; don't buy them.

Never use side-cutters for cutting nails, bolts, or heavy wire; you will ruin them.

Courtesy Utica Drop Forge and Tool Corp.

FIG. 5. This is the type of side-cutting pliers you will find most useful.



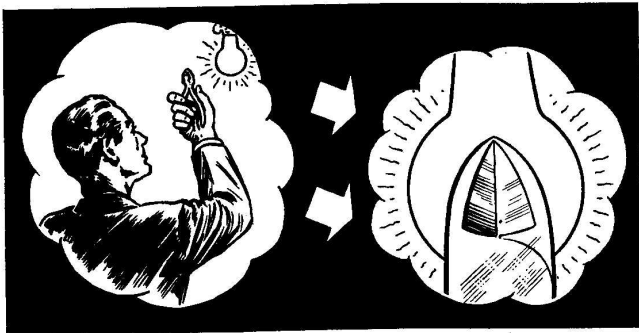
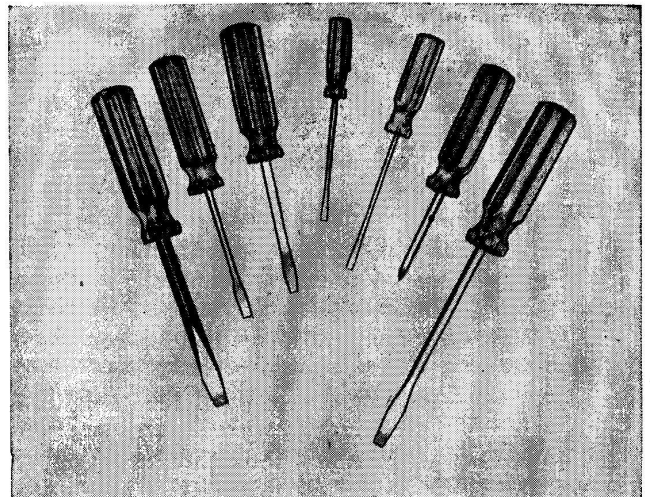
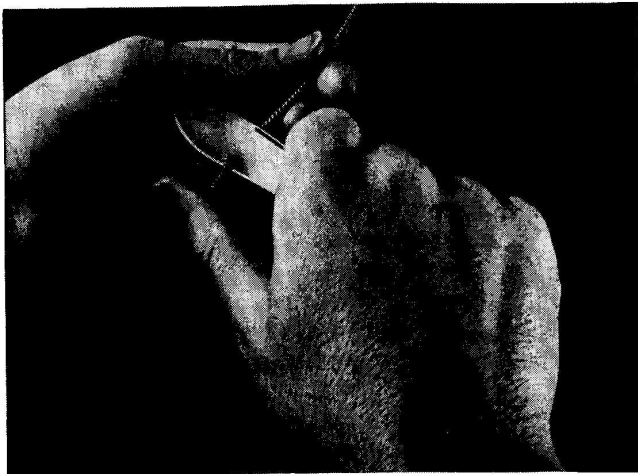


FIG. 6. Test side cutters by holding them up to the light. No light should be seen between the cutting edges.

Jackknife. Right from the start you will need a jackknife with a rugged blade. A typical knife is shown in use in Fig. 7, trimming insulation from a wire. Always be careful not to cut into the wire you are cleaning, as a deep nick will weaken it. Since scraping wires will dull even the best knife blade, some servicemen use an old knife or just one blade (or only part of one blade) for this purpose.

Never use a jackknife as a screwdriver. Don't cut wires with it either; you are certain to nick the blade.

FIG. 7. How to cut off insulation with a jackknife.



Courtesy Vaco Products Company

FIG. 8. These are the screwdriver sizes you will find most useful in servicing.

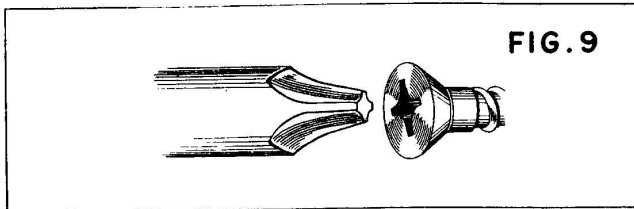
SCREWDRIVERS

Screws of all sizes are used in radios—from big wood or machine screws used to mount large radios in their cabinets, down to tiny set screws used to hold control knobs on their shafts. Some screws are easy to reach, others are difficult. You will need both short- and long-bladed screwdrivers.

It is very important that the screwdriver tip fit the screw slot snugly so that the screw will be relatively easy to turn. Tips that are too wide, narrow, thin, or thick for the slot tend to twist off the head, chew up the slot, or make the screw hard to turn. You will need several screwdrivers to fit the various screws found in radios.

Fig. 8 shows a good beginning assortment of screwdrivers. There are six conventional types: two with small tips (these can both be the same length—you need two mostly because they are easily mislaid); three with medium tips, in the shaft lengths and weights shown; and one heavy-duty type with a medium-length shaft. You can add other medium-tip sizes later if you find you need them.

The sixth screwdriver shown in Fig. 8 is intended



for use with the Phillips screw, now used in many radios. As Fig. 9 shows, this screw has a recess instead of a slot in the head and requires a special screwdriver. Because of the taper of the recess in the screw head, one Phillips screwdriver will take screw sizes up to No. 4, and another will take sizes 5 to 9. These two Phillips screwdrivers will be the only ones you will need in radio work. You will need both almost as soon as you start servicing.

► Screwdrivers with the hold-tight feature shown in Fig. 10 are handy for starting screws in hard-to-reach places. Get a medium and a small one of this type after a while.

► When you buy a screwdriver, be sure that the blade will not loosen under strain and turn at the handle. While some wooden-handle screwdrivers are satisfactory, the best for radio work are those with shanks molded into handles of transparent, insulating plastic. One point—keep these handles away from heat and flame; they will burn.

SOLDERING IRON

The most used of all your tools will be the soldering iron. Whenever you replace a part or disconnect a lead, you will unsolder and resolder one or more connections.

FIG. 10. The clamp on the end of the screwdriver is handy for holding the screw until it is well started in the work.

Courtesy Vaco Products Company

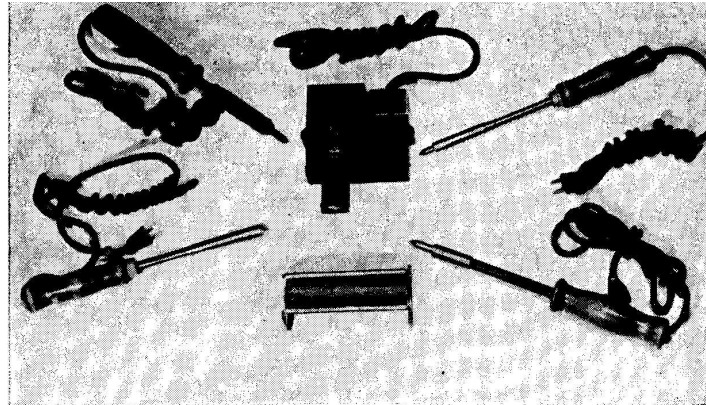
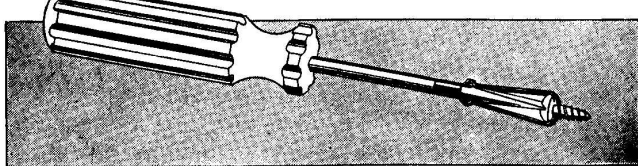


FIG. 11. The American Beauty temperature-regulating stand shown in the center top of the picture is excellent for keeping an iron at the right temperature for ready use.

Fig. 11 shows several soldering irons and soldering-iron stands.

DON'T BUY A SOLDERING IRON AT THIS TIME. We send you one with your first experimental kit (RK kit) and include both a stand and a supply of solder. This iron is intended for use with the experiments, but it is a practical, light-weight iron which you can use when you start repairing radios. Later you may find it worth while to get a heavy-duty, slow-heating iron for use at your workbench, and save this lighter iron for use on service calls in the customer's home.

When the time arrives for you to get this second iron, get a heavy-duty one rated at 100 watts. (If you do not have electricity, get a half-pound tinner's iron.) In the most efficient electric irons, the tip either will screw down over the element, or will be a rod that fits into a socket in the iron. Both types give good transfer of heat. A $\frac{3}{8}$ -inch tip is the best size for most radio work, for it is small enough to use in tight places, and yet large enough to build up a good heat reserve.

Soldering Techniques. It is very important to solder properly. A poorly soldered joint can cause an open circuit, or an intermittent contact may develop that will cause noise and other troubles. If an excess of solder is used, it may run down from the joint and cause a short circuit. In your first experimental kit, you'll get

TABLE 1 HOW TO MAKE A GOOD SOLDERED JOINT

1. KEEP YOUR SOLDERING IRON CLEAN AND WELL TINNED.
2. REMOVE INSULATION FROM WIRES, AND SCRAPE OFF EXCESSIVE DIRT. AVOID NICKING THE WIRE WITH THE SCRAPING TOOL.
3. USE ONLY ROSIN-CORE SOLDER FOR RADIO WORK.
4. TIN EACH PART SEPARATELY IF ORIGINALLY UNTINNED.
5. MAKE GOOD MECHANICAL CONTACT BETWEEN THE PARTS BEING SOLDERED.
6. APPLY THE SOLDER TO THE LUG OR WIRE, NOT TO THE SOLDERING IRON.
7. DO NOT MOVE THE JOINT UNTIL THE SOLDER HARDENS.

detailed instructions on how to solder, and lots of practice.

However, you can't get too much practice—soldering is an art. An astounding number of receivers are serviced only because of poor soldering. Learn the rules in Table 1, and practice them constantly in your work. If you do make a poor joint, don't fail to do it over. Remember—*good soldering is essential*.

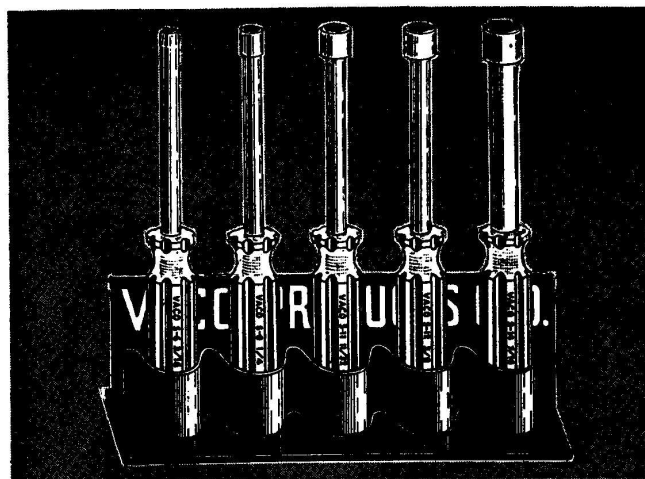
Hints on Unsoldering. Unsoldering, the reverse of soldering, is considerably easier. To unsolder, simply apply the iron tip to the joint until the solder melts. (If a coating of oxide or grease keeps it from melting, apply a very little flux to the solder with the end of a toothpick and bring the iron to the joint.) You can then pull the wire gently with a pair of pliers and break the joint. Never jerk or pull too hard; you may break leads, soldering lugs, or the parts themselves.

You can readily pick up excess solder from a joint by holding the hot tip under it. The solder that runs down onto the iron can be shaken off onto the shop floor. Repeat this until only a little solder is left on the joint, then, as it cools, wiggle the leads back and forth so the remaining solder cannot set properly. In many cases, this makes it easy to untwist and remove the leads.

If it proves too difficult to remove leads this way, just cut one wire with a pair of cutters. You can then remove the small end of the wire if it is in the way of a new connection.

SOCKET WRENCHES

Socket wrenches are better than pliers for removing

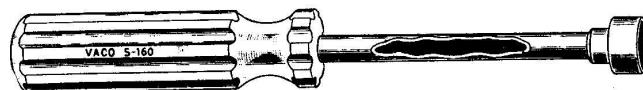


Courtesy Vaco Products Company

FIG. 12. A useful set of socket wrenches in a convenient holder.

nuts from bolts. A socket wrench fits over the nut and does not slip off. You do not have to move it to get another grip; just "spin" the nut right off.

Socket wrenches come in sets like that shown in Fig. 12, or may be bought individually. They come in sizes to fit nuts of: $3/16"$ — $7/32"$ — $1/4"$ — $9/32"$ — $5/16"$ — $11/32"$ — $3/8"$ — $7/16"$ — $1/2"$. A set, one of which you



Cut-away view of one of the wrenches shown above. Notice that the shaft is hollow—this permits the wrench to be fitted over long bolts.

should get soon after you start servicing, contains the most used sizes. Eventually, you will want a complete collection of these handy tools. Special types ($1/2"$ and $9/16"$) with extra-deep hollow shafts are available for removing volume control nuts.

Good socket wrenches are expensive, so wait until your service earnings will pay for them—cheap types are a waste of money. A good one has a socket that is

free from burrs and is of sufficient depth to fit over two nuts. Also, a good wrench has a shaft that is hollowed out for a considerable distance, so that the wrench can fit down over long bolts to engage the nut; some cheaper wrenches do not have this feature. Furthermore, the better types have thin, strong sockets which can get into small spaces.

The better sets have stands, so you can keep them together and in order. Recently, plastic-handled types have been made with different colored handles; the size can be recognized by the color—this is a real time-saver.

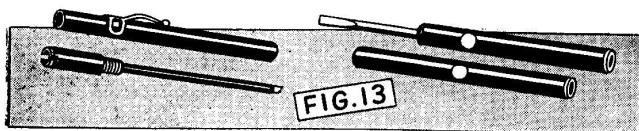
MISCELLANEOUS ITEMS

Alignment Tools. With age, receivers get out of adjustment, losing their pep or their ability to separate signals from different stations. To restore the set to its original characteristics, it is "aligned" by resetting a number of variable adjusters.

It is possible to align many radio receivers with ordinary screwdrivers and socket wrenches. However, for greatest ease and most accurate work, alignment tools should be used. Typical examples of these tools are given in Fig. 13.

These tools are small screwdrivers and wrenches made from plastic materials instead of metal. This eliminates the upsetting effect of bringing metal near certain adjusting screws and nuts, thus making it easier to align accurately. These tools can be obtained from almost any radio supply house—individually or in complete kits. Naturally, you won't need them until you learn how to align a receiver.

Tool Box. You will need a tool box right from the start to carry your tools with you on service calls. A sectional or tackle box like that shown in Fig. 14 is best: you can see all the tools when you open the box, and you can keep your tools separated according to types so that you can find them easily.



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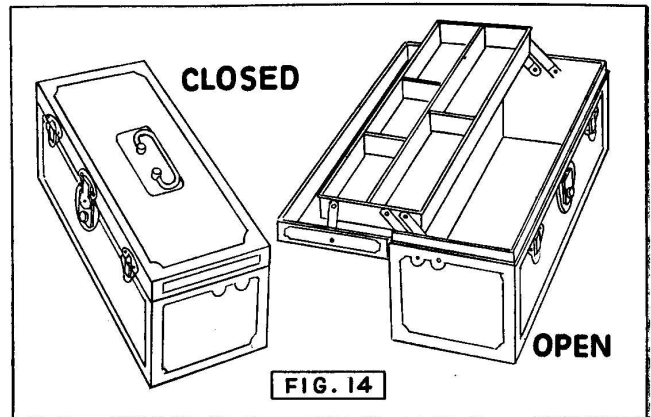


FIG. 14

Have a place in your box for each tool, and put it there as soon as you are through using it. Otherwise, you'll often leave tools in your customers' homes. Don't toss the tools into the box either; the clatter is annoying, and you might miss and scar some furniture. Remember—you will be working right in the living room, perhaps surrounded by interested onlookers. The condition of your tools, and the way you treat them, will have much to do with the impression you make on the customer.

Empty your tool box regularly in your shop and clean both it and the tools carefully. Many servicemen place small bits of wire, excess solder, and other odds and ends in the tool box when in the home of the customer. It is perfectly all right to clean up this way—in fact, it makes a good impression on the customer—but be sure to remove this junk when you get back to your shop. Don't carry useless tools, either.

Hardware. A certain amount of hardware will be necessary as soon as you start your service business. You'll need a roll of hook-up wire, a roll of friction or tire tape, and an assortment of screws and nuts.

The most used screws for mounting radio parts are 6-32 and 8-32 machine screws. (By the way, say "six thirty-two" and "eight thirty-two," not "six thirty-second" or "eight thirty-second.") The six in 6-32 refers to the diameter of the wire from which the screw is made, and the thirty-two tells the number of threads

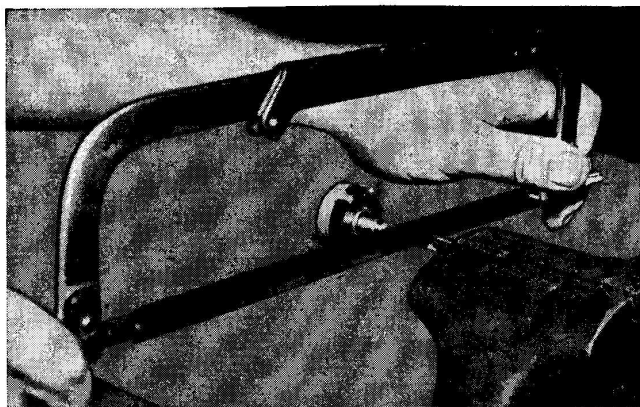


FIG. 15. Cutting off a volume control shaft with a hacksaw. This is a common radio servicing job.

to the inch. The lengths you will need in radio service work are $\frac{1}{4}$ -inch and $\frac{1}{2}$ -inch. One gross each of $\frac{1}{4}$ -inch and $\frac{1}{2}$ -inch 6-32 and 8-32 (round or binder head) machine screws, with nuts to fit, makes a good stock. Get screws that are cadmium- or nickel-plated (to prevent rust), and keep them separated according to sizes in small glass jars.

Eventually, you will probably get a box of assorted wood screws, and perhaps another box of assorted self-tapping screws. The latter do not require nuts; they cut a thread in metal and thus hold themselves.

WORKBENCH TOOLS

The tools we've mentioned so far are those you will use both at the workbench and on service calls. There are others that you will eventually find desirable for use at your workbench.

Hacksaw. You'll need a hacksaw fairly soon for sawing the shafts off volume or tone controls, to make them the correct length. (General-purpose replacement controls come with extra long shafts so that they may be fitted to different receivers.) A typical hacksaw is shown in use in Fig. 15. Here are some pointers on using a hacksaw:

1. Place the blade on the frame holding-pins, with

the blade teeth pointing away from the handle.

2. Adjust the blade between the frame holding-pins so that there will be no twist, and keep it stressed tightly.

3. Bear down sufficiently hard on the forward stroke to make the blade cut into the work. If the teeth merely slide over the work, their cutting edges will be dulled.

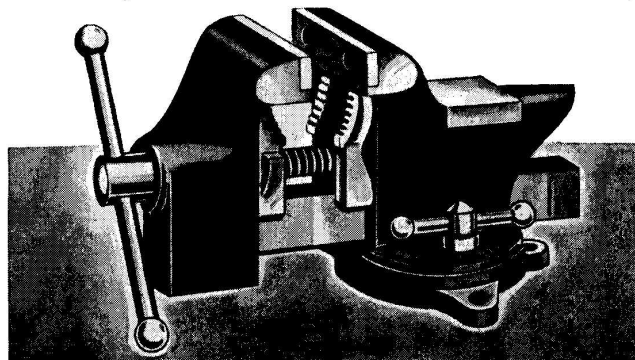
4. Lift the saw slightly on the return stroke to disengage the teeth—otherwise they will be dulled.

5. Don't saw too fast; you'll overheat the blade and cause it to lose its hardness. About forty strokes per minute is satisfactory for general work.

Hacksaw blades come in 8-, 10-, and 12-inch lengths. Be sure to get blades the right length for your holder (unless it is adjustable for various lengths). Blades are made with 14, 18, 24, or 32 teeth to the inch, depending on the cutting job they must do: those with fewer teeth are for soft metals like aluminum alloys, zinc, and copper, while those with closely set teeth are for iron, steel, and other hard metals. Blades with 24 teeth to the inch are most useful for radio work, but eventually you'll want others also. For instance, a fine-toothed blade is necessary for cutting thin metal (such as a chassis).

Vise. Eventually, you will need a husky vise like that shown in Fig. 16 for such jobs as holding a volume-control shaft firm while you cut it and for holding the soldering iron steady while you clean the tip with a file.

FIG. 16. A vise like this is the best kind for service work. The jaws should be at least 3 or 4 inches wide.



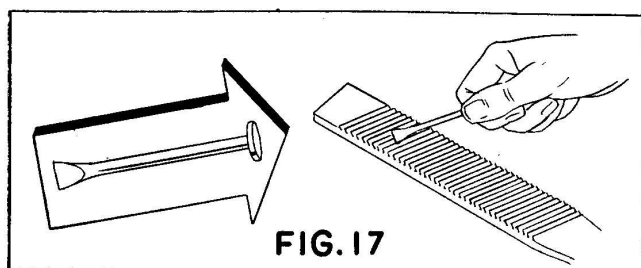


FIG. 17

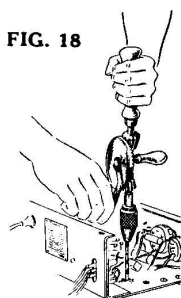
Get a strong vise that has 3- or 4-inch jaws and can be locked in any desired position. Bolt it firmly to your bench.

Files. One flat file and one round or rat-tail file will prove useful to you almost at once. The rougher the work or the softer the metal to be smoothed, the coarser the file should be. Get a medium-sized double-cut bastard flat file at first. A double-cut file has teeth in two sets of rows, the sets crossing each other at an angle. The term bastard refers to the rather coarse size of the teeth or degree of cut. Other cuts are known as second-cut, smooth, and dead-smooth, each of which is finer-toothed than the one mentioned before it. If too fine a file is used, the teeth quickly clog with "pins" (particles of metal).

When filing, hold the lower end of the file between the thumb and first finger of your left hand and the handle in your right hand. Move the file back and forth across the work in a direction parallel with the length of the file. Use pressure only on the forward or downward stroke, and release the pressure on the backward stroke so that you will not break the file teeth.

► When file teeth clog they must be cleaned. A special wire brush is available for this purpose, but you can easily make a satisfactory cleaning tool. Hammer the point of a large nail until it becomes spade-shaped. File this flat end square until the nail looks like the one in Fig. 17. Now hold the nail at an angle and work it back and forth across the file, in the same direction as the rows of teeth. This will

FIG. 18



cut teeth in the end of the nail that will fit down into the ridges on the file and scrape out all the metal particles.

Don't abuse your files. They are very hard and brittle. If you throw one on top of another in the tool box, the teeth or the whole file may break. Don't use a file as a prying tool—it will be sure to break.

Hand Drill. A hand drill is very useful for removing rivets holding parts to a chassis or for making new mounting holes in a chassis. You'll need one soon after you start servicing. An ordinary hand drill, with a three-jawed chuck capable of taking round-shank drills up to 1/4-inch size, is all that is necessary for radio work. Fig. 18 shows a typical drill in use.

► You will, of course, need some drill points or drills. There are two kinds—carbon and high-speed. The carbon type is cheap and entirely satisfactory for use in a hand drill. Only high-speed drills should be used in electric drills, because they run so fast that they will over-heat and destroy a carbon drill-point.

Fig. 19 shows a typical drill point and a table giving the numbers for the drill sizes that you will be most likely to use.

Even the best drills become dull with use. Carbon drills cost so little you may as well discard them, but it pays to have high-speed drills sharpened by a machinist. Don't try to sharpen them yourself unless you are experienced in doing so.

Always turn a drill slowly enough and use enough pressure so that the drill point will not slide.

After drilling a hole, particularly through thin metal, you may find a rough burr on the side where the drill

| Drill No. | Diam. (in.) | Clears Screw |
|-----------|-------------|--------------|
| 4 | .2090 | 12-20 |
| 10 | .1935 | 10-32 |
| 18 | .1695 | 8-32 |
| 28 | .1405 | 6-32 |
| 33 | .1130 | 4-40 |

point came through. You can easily remove this burr with a counter-sink or with a drill about twice the size of the one you used to make the hole. Wrap the shank end of the drill in a piece of cloth, grasp it firmly with

FIG. 19. These five drills will take care of most service work. Order them by number.

your fingers, hold the cutting point to the burr side of the hole, and turn the drill clockwise. This will trim off the burr and leave a smooth edge.

When you have to make a hole much larger than the drills you have, either drill a series of small holes and smooth the hole out with a file, or drill as large a hole as possible and use a reamer.

Hammer, Punch, and Cold Chisel. You'll probably need a hammer and a punch fairly soon. Any ordinary household hammer will do for radio work. A small center punch is helpful when you have to drill holes in a chassis. (Unless there is a starting indentation, a drill point will tend to skid about rather than enter the desired point.) To make a mark with a punch, center the point of the punch at the spot where you wish to drill and strike the top of the punch sharply with a hammer.

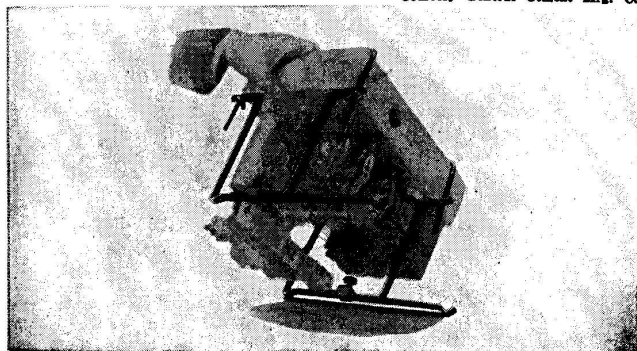
Before using a punch, take all the tubes out of the chassis so they won't be jarred by the blow, and, if possible, support the chassis at the point you plan to punch. A block of hardwood is just right for this. If it is impossible to put a support under it, don't strike hard enough to bend the chassis.

You will occasionally find a cold chisel useful for making a large, square hole in a chassis or for knocking off rivet heads.

Marking Tools. You will find occasional use for a wood or metal ruler. A pair of dividers will be helpful at

FIG. 20. A chassis cradle like this makes it much easier to work on a chassis without danger of injuring any parts.

Courtesy General Cement Mfg. Co.



times in determining the spacing between holes, although usually the ruler will be sufficient.

You can mark on most receivers with a pencil, although some are finished so that a sharp-pointed scribe must be used. In a pinch, an ordinary straight pin can be used to scratch a mark on a chassis.

TIME-SAVING TOOLS

We'll mention now a few tools you *won't* need until you get a large shop. Before then, the time you can save with these tools won't be worth their cost.

Chassis Cradle. Often, a receiver must be turned upside-down so that you can work underneath it. In some cases there will be large parts, such as transformers and electrolytic condensers, so placed on top of the chassis that they will make steady supports while the chassis is turned over; but frequently you'll find a delicate part, such as the tuning mechanism, so placed that it will be damaged if the weight of the chassis rests on it.

Most servicemen use boxes, wooden blocks, or old radio parts to support the chassis. However, a chassis cradle like that shown in Fig. 20 is better. With the chassis fastened in such a cradle, it may be placed in any desired working position without danger of damaging any parts in the receiver.

Wire Strippers. Much of the wire used by servicemen has push-back insulation. You simply push back the insulation with your thumb and forefinger to uncover an end for soldering. However, some wires are covered by braided, plastic, or rubber insulation, which must be cut off the wire. Although you can cut this with a sharp knife if you are careful to avoid nicking the wire, it is a rather awkward procedure in tight places. In such cases, the wire-stripping tool shown in Fig. 21 is quite a time-saver. This tool strips off insulation neatly and cleanly, without nicking the wire.

Ratchet Screwdrivers. The ratchet screwdriver shown in Fig. 21 is convenient for removing and replacing long screws. Only the best grade ratchets last very long and have the necessary mechanical strength to tighten large screws firmly.

Auto Radio Tools. If you specialize in installing automobile receivers, you will find that both an adjustable end-wrench and an electric drill are necessary tools. Fig. 21 illustrates both.

CONSTRUCTIONAL TOOLS

The following tools are rarely necessary in a radio service shop, but will prove useful if you ever specialize in building or remodeling radio equipment. Naturally, you won't even consider entering these fields until you have had plenty of servicing experience, so you won't need these tools for some time:

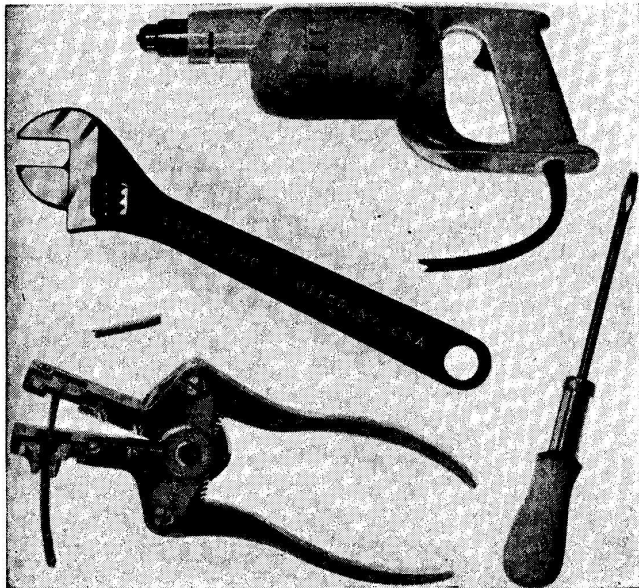
a. *Reamer and brace.* These are used to enlarge holes drilled in metal.

b. *Tap wrench and tap.* These are used to cut screw threads in drilled holes.

c. *Socket punch.* This is used to cut a hole in a chassis

FIG. 21. The electric drill (top) and the adjustable end wrench (center) are needed for auto-radio work. The wire stripper (bottom left) and the ratchet screwdriver (bottom right) are speed-up tools that come in handy in the well-established shop.

End Wrench, Courtesy Utica Drop Forge and Tool Corp.
Wire Stripper, Courtesy General Cement Mfg. Co.



for a tube socket or the socket of an electrolytic condenser.

d. *Power tools.* A drill press and other power tools will be very useful if you do much constructional work.

A Look Ahead. You will need some place on which to work. At the beginning, all you need is a reasonably solid flat surface. Later, you will find you need a regular workbench; that will be time enough to consider making one. A future RSM Booklet will give you plans and constructional data for several types of workbenches.

Your next RSM Booklet, "Equipment Used by Servicemen," will tell you the basic features of testing equipment that servicemen use. Before you tackle RSM-3, however, study Lesson No. 3 of the regular Course, so you will be able to understand thoroughly everything in this practical Booklet.

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